

## CLAIMS

We claim:

- 1           1.     A method of reducing the shop time of locomotives at a locomotive  
2 maintenance facility comprising:  
3           providing data gathering systems onboard a locomotive and a historical data  
4           base of locomotive system data on a plurality of similar locomotives,  
5           said data base being stored off-board of said locomotive, and said  
6           locomotive system data being selected from the group consisting of  
7           ambient air temperature, train notch, total track and force power, total  
8           voltage, total amps, software versions, engine RPM, engine  
9           temperature, crankcase pressure, dynamic braking, battery voltage, and  
10          voltage and amperage for all auxiliary motors;  
11          obtaining onboard locomotive systems data with said onboard data gathering  
12          systems during operation of said locomotive, prior to arrival of said  
13          locomotive at a locomotive maintenance facility for scheduled  
14          maintenance;  
15          transmitting said onboard systems data via wireless communications to a  
16          remote data center prior to arrival of said locomotive at said  
17          maintenance facility;  
18          prior to arrival of said locomotive at said maintenance facility, comparing said  
19          onboard system data with said historical data base to determine  
20          whether any of said onboard system data is out of a predetermined  
21          range or is within said predetermined range, but exhibiting a trend  
22          toward being out of said range;  
23          prior to arrival of said locomotive at said maintenance facility, assigning at  
24          least one fault code corresponding to at least one system fault based on  
25          said onboard systems data being either out of said range or exhibiting a  
26          trend toward being out of said range, said at least one fault code being  
27          selected from the group consisting of overcurrents, flashovers,  
28          crankcase overtemperatures, crankcase overpressures, communication  
29          failures, electrical ground failures, air conditioner converter failures,

30 propulsion system faults, auxiliary system faults, propulsion motor  
31 faults, auxiliary motor faults, auxiliary system charging faults, engine  
32 cooling system faults, oil system faults, control wiring faults, and  
33 microelectronics faults;  
34 prior to arrival of said locomotive at said maintenance facility, determining  
35 any maintenance and repair operations to be performed when said  
36 inbound locomotive arrives at said maintenance facility, in response to  
37 said at least one fault code; and  
38 communicating said determination of maintenance and repair operations to  
39 said maintenance facility before said locomotive arrives at said  
40 maintenance facility.

1 2. The method recited in claim 1, further comprising classifying each said  
2 maintenance and repair operation into a classification selected from the group  
3 consisting of required, advisable, and optional operations, prior to arrival of said  
4 locomotive at said maintenance facility.

1 3. The method recited in claim 1, wherein said onboard systems data is  
2 determined to be within said predetermined range, but exhibiting a trend toward being  
3 out of range, by comparing a series of values for a given parameter over a period of  
4 time.

1 4. The method recited in claim 1, wherein said historical data base is  
2 comprised, at least in part, of data collected from prior downloads of onboard systems  
3 data.

1 5. The method recited in claim 1, wherein said remote data center is  
2 located at said remote maintenance facility.

1           6.       A system for reducing the shop time of locomotives at a locomotive  
2 maintenance facility comprising:  
3           a plurality of data gathering systems onboard a locomotive, said data gathering  
4               systems being adapted to obtain onboard locomotive systems data  
5               during operation of said locomotive, prior to arrival of said locomotive  
6               at a locomotive maintenance facility for scheduled maintenance;  
7           a computer off-board of said locomotive, said computer storing a historical  
8               data base of locomotive system data on a plurality of similar  
9               locomotives, said locomotive system data being selected from the  
10              group consisting of ambient air temperature, train notch, total track and  
11              force power, total voltage, total amps, software versions, engine RPM,  
12              engine temperature, crankcase pressure, dynamic braking, battery  
13              voltage, and voltage and amperage for auxiliary motors;  
14           a wireless communication system, said wireless communication system being  
15               adapted to transmit said onboard systems data to a remote data center  
16               prior to arrival of said locomotive at said maintenance facility;  
17           data comparison software adapted to compare said onboard system data with  
18               said historical data base prior to arrival of said locomotive at said  
19               maintenance facility, to determine whether any of said onboard system  
20               data is out of a predetermined range or is within said predetermined  
21               range, but exhibiting a trend toward being out of said range;  
22           fault code assignment software adapted to assign, prior to arrival of said  
23               locomotive at said maintenance facility, at least one fault code  
24               corresponding to at least one system fault based on said onboard  
25               systems data being either out of said range or exhibiting a trend toward  
26               being out of said range, said at least one fault code being selected from  
27               the group consisting of overcurrents, flashovers, crankcase  
28               overtemperatures, crankcase overpressures, communication failures,  
29               electrical ground failures, air conditioner converter failures, propulsion  
30               system faults, auxiliary system faults, propulsion motor faults,  
31               auxiliary motor faults, auxiliary system charging faults, engine cooling

32                   system faults, oil system faults, control wiring faults, and  
33                   microelectronics faults; and  
34           diagnostic software adapted to determine, prior to arrival of said locomotive at  
35           said maintenance facility, any maintenance and repair operations to be  
36           performed when said inbound locomotive arrives at said maintenance  
37           facility, in response to said at least one fault code;  
38           wherein said wireless communication system is adapted to transmit said  
39           determination of maintenance and repair operations to said remote data  
40           center prior to arrival of said locomotive at said maintenance facility.

1           7.       The system recited in claim 6, further comprising classification  
2           software adapted to classify each said maintenance and repair operation into a  
3           classification selected from the group consisting of required, advisable, and optional  
4           operations, prior to arrival of said locomotive at said maintenance facility.

1           8.       The system recited in claim 6, wherein said data comparison software  
2           determines that said onboard systems data is within said predetermined range, but  
3           exhibiting a trend toward being out of range, by comparing a series of values for a  
4           given parameter over a period of time.

1           9.       The system recited in claim 6, wherein said historical data base is  
2           comprised, at least in part, of data collected from prior downloads of onboard systems  
3           data.

1           10.      The system recited in claim 6, wherein said remote data center is  
2           located at said remote maintenance facility.